

MULTIMEDIA



UNIVERSITY

STUDENT ID NO

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MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2021/2022

DMA5101 – MATHEMATICAL TECHNIQUES 1
(TC1V)

9 AUGUST 2022
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

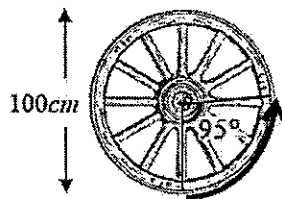
1. This question paper consists of 3 pages (2 pages with 4 questions and 1 page of appendix). Key formulae are given in the Appendix.
2. Answer ALL questions.
3. Please write all your answers in the Answer Booklet provided.
4. All necessary working steps must be shown.

QUESTION 1**[10 Marks]**

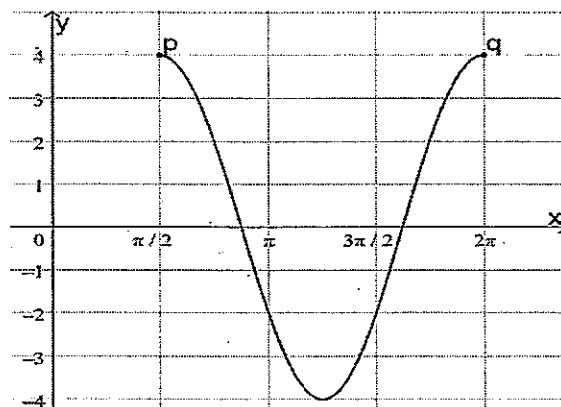
- a) A toy rocket is launched with an initial velocity of 32 m/sec from a height of 20 m . The function $s(t) = -16t^2 + 32t + 20$ gives the height of the rocket, in metre (m), t seconds after it has been launched.
- Determine the time at which the rocket reaches its maximum height and find the maximum height. (1.5 marks)
 - How long will it take for the rocket to return to the ground? (3 marks)
 - Sketch the parabolic paths for the rocket in x - y axis. (1.5 marks)
- b) Given $f(x) = (x^2 - 4)(x^2 + 10x + 25)$. Find the x -intercepts. State whether the graph crosses the x -axis, or touches the x -axis and turns around, at each intercept. (4 marks)

QUESTION 2**[15 Marks]**

- a) The diameter of a wheel rolling on the ground is 100 cm . If the wheel rotates through an angle of 95° , how many centimetres does it move? Approximate to the nearest integers. (3 marks)



- b) A house painter wants to lean a 5.8 m ladder against a house. If the angle between the base of the ladder and the ground is to be 60° , how far from the house should she place the base of the ladder? (2.5 marks)
- c) Given $w = \sqrt{7}(\cos 65^\circ + i \sin 65^\circ)$. Use De Moivre's Theorem to find w^6 . Hence, write w^6 in the standard form $a + bi$. (Leave your answer in fraction form) (3.5 marks)
- d) Given below is the graph for cosine function where point $p = (\frac{\pi}{2}, 4)$ and $q = (2\pi, 4)$.



- Determine the amplitude, period and phase shift. (2 marks)
- Identify the cosine function $y = A \cos(Bx - C)$ for this graph by finding the values of A, B and C . (4 marks)

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QUESTION 3**[15 Marks]**

a) Find matrix M if $\begin{bmatrix} 2 & -3 \\ 4 & 5 \end{bmatrix}^T + 2M = 3 \begin{bmatrix} 12 & -4 \\ 0 & 5 \end{bmatrix}$. (2 marks)

- b) The number of online sales made via two websites on a particular weekend is shown in the table below. Both online shopping websites sell each cloth at RM x and each pair of shoes at RM y . Shopii and Lazara accumulated RM 759 and RM 817 respectively from their online sales.

	Cloth	Shoes
Shopii	18	15
Lazara	9	20

Calculate the price for each cloth, x and the price for each pair of shoes, y by using the **inverse matrix method**. (4.5 marks)

- c) Given a system of equations below:

$$\begin{cases} 2x + 3y + z = 0 \\ 2x + 2y + 2z = 20 \\ x + 5y + 3z = 8 \end{cases}$$

Solve the linear system by using the **Cramer's Rule method**. (8.5 marks)

QUESTION 4**[10 Marks]**

- a) Given that $\mathbf{a} = 3\mathbf{i} + 6\mathbf{j} - \mathbf{k}$ and $\mathbf{b} = \mathbf{i} - 3\mathbf{j} + 5\mathbf{k}$. Find $2\mathbf{a} + 4\mathbf{b}$. (1.5 marks)
- b) Find the area of a triangle PQR enclosed by the vectors $\overrightarrow{PQ} = \langle 2, 5, -3 \rangle$ and $\overrightarrow{PR} = \langle 7, -1, 2 \rangle$. (2.5 marks)
- c) Find an equation of the plane that passes through the point $(5, -2, -1)$ and with normal vector $8\mathbf{i} + 2\mathbf{j} - \mathbf{k}$. (2 marks)
- d) Find the angle between the planes $4x - y + 5z = 1$ and $4x + 7y + 4z = 1$. (4 marks)

Continued...

APPENDIX

Quadratic formula:

If $ax^2 + bx + c = 0$ where $a \neq 0$, then
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Standard form of a quadratic function:

$$f(x) = a(x - h)^2 + k, a \neq 0$$

Trigonometric functions:

$$y = A \sin(Bx - C) \quad \text{or} \quad y = A \cos(Bx - C)$$

amplitude = $|A|$, period = $\frac{2\pi}{B}$, and phase shift = $\frac{C}{B}$

Products and quotients in polar form:

$$z_1 z_2 = r_1 r_2 [\cos(\theta_1 + \theta_2) + i \sin(\theta_1 + \theta_2)]$$

$$\frac{z_1}{z_2} = \frac{r_1}{r_2} [\cos(\theta_1 - \theta_2) + i \sin(\theta_1 - \theta_2)]$$

De Moivre's theorem:

$$z^n = r^n [\cos(n\theta) + i \sin(n\theta)]$$

Length of vector:

The length of the vector $\mathbf{a} = \langle a_1, a_2, a_3 \rangle$ is $|\mathbf{a}| = \sqrt{a_1^2 + a_2^2 + a_3^2}$.

Dot Product

If θ is the angle between the vector $\mathbf{a} = \langle a_1, a_2, a_3 \rangle$ and $\mathbf{b} = \langle b_1, b_2, b_3 \rangle$, then

$$\mathbf{a} \cdot \mathbf{b} = a_1 b_1 + a_2 b_2 + a_3 b_3 = |\mathbf{a}| |\mathbf{b}| \cos \theta$$

Cross Product

If θ is the angle between the vector $\mathbf{a} = \langle a_1, a_2, a_3 \rangle$ and $\mathbf{b} = \langle b_1, b_2, b_3 \rangle$, then

$$\mathbf{a} \times \mathbf{b} = \langle a_2 b_3 - a_3 b_2, a_3 b_1 - a_1 b_3, a_1 b_2 - a_2 b_1 \rangle$$

$$\text{Area of triangle } PQR = \frac{1}{2} |\vec{PQ} \times \vec{PR}|$$

Equation of lines

Vector equation: $\mathbf{r} = \mathbf{r}_0 + t\mathbf{v}$

Equation of planes

Scalar equations: $a(x - x_0) + b(y - y_0) + c(z - z_0) = 0$

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